Coronavirus (COVID-19) — An epidemic or pandemic for financial markets

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ABSTRACT

The novel Coronavirus disease (COVID-19) has quickly evolved from a provincial health scare to a global meltdown. While it has brought nearly half the world to a standstill it has affected the financial markets in unseen ways by eroding a quarter of wealth in nearly a month. This paper investigates the reaction of financial markets globally in terms of their decline and volatility as Coronavirus epicentre moved from China to Europe and then to the US. Findings suggest that the earlier epicentre China has stabilized while the global markets have gone into a freefall especially in the later phase of the spread. Even the relatively safer commodities have suffered as the pandemic moves into the US.

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1. Introduction

The Coronavirus (COVID-19) outbreak in December 2019 in Wuhan (China), has infected over one million people and excess of 60,000 deaths globally in nearly 100 days.[1] The scale and trajectory of the spread have led the World Health Organization (WHO) to declare COVID-19 firstly as a global emergency on Feb. 20, 2020, and then a pandemic on 11th March. The major stock markets have witnessed a decline in double figures with S&P 500 taking 16 trading days to post a 30% decline.

We investigate the impact of this colossal health crisis on major stock markets and commodity markets to better understand the response of investors. By dividing our sample into two parameters, firstly, Epidemic (Dec 2019 to March 10, 2020) and Pandemic (-post-March 10, 2020[2]) and secondly, on the global spread, Phase 1, where coronavirus deaths were limited to China; Phase 2, European Spread and Phase 3, North American Spread,

we have interesting findings. We find that Chinese markets displayed relative calm with lower volatility during both epidemic and pandemic period which negates the recent work of Zhenghui and Junhao (2019), who argue that Chinese markets are more susceptible to uncertainty shocks emanating from China. On the other hand, the average volatility of stock markets in the US, UK, Germany and South Korea increased as Coronavirus moved from epidemic to pandemic stage. Secondly, the European indices showed the highest volatility in the US phase even though the European phase (Phase II) has recorded a higher fatality rate. These findings conform to studies of Antonakakis et al. (2013), Chen and Chiang (2020) and Tiwari et al. (2019), who have studied the impact of economic uncertainty on financial market volatility.

The existing literature is limited to the impact of global health crises like current, as the scale of this pandemic has not been witnessed in over a century. Recent working papers on impact of Coronavirus noted that the new cases reported in China and outside China have a mixed effect on financial volatility, while the deaths reported that outside China triggered a more powerful impact (Albulescu, 2020). Al-Awadhi et al. (2020) is the only empirical paper, published recently, which directly links COVID impact with stock market returns. In this paper, we are further

Table 1
Statistics for returns and volatility for complete period.

	Daily return				EGARCH volatility			
	Mean	Standard dev	Min	Max	Mean	Standard dev	Min	Max
WRLD	−0.61%	2.73%	−10.44%	5.75%	0.07%	0.11%	0.00%	0.48%
EUR	−0.69%	2.46%	−14.06%	1.81%	39.23%	291.80%	0.00%	2203.55%
USA	−0.59%	3.34%	−12.92%	8.71%	0.11%	0.18%	0.00%	0.93%
ASIA	−0.49%	1.46%	−5.19%	2.75%	0.02%	0.02%	0.00%	0.09%
ITL	−0.77%	3.49%	−20.54%	6.60%	0.45%	1.96%	0.01%	13.21%
SPN	−0.74%	3.07%	−17.22%	5.32%	0.29%	1.24%	0.01%	8.87%
CHN	−0.29%	1.86%	−6.09%	3.79%	0.04%	0.04%	0.00%	0.18%
GER	−0.77%	2.67%	−15.09%	3.69%	0.06%	0.08%	0.00%	0.27%
FRA	−0.74%	2.78%	−14.90%	5.12%	0.07%	0.11%	0.00%	0.39%
KOR	−0.66%	2.97%	−11.00%	10.05%	0.08%	0.10%	0.01%	0.44%
SWZ	−0.38%	2.02%	−11.33%	3.91%	1.03%	5.27%	0.01%	32.17%
UK	−0.85%	2.52%	−14.21%	1.57%	0.05%	0.07%	0.00%	0.22%
BC	−0.31%	6.28%	−31.57%	15.83%	0.29%	0.37%	0.03%	1.53%
WTI	−1.48%	7.31%	−38.83%	21.36%	1.74%	8.19%	0.00%	62.11%
GLD	−0.04%	1.31%	−4.88%	2.59%	0.02%	0.01%	0.01%	0.09%
Trsry	0.12%	0.72%	−2.10%	1.82%	0.50%	0.74%	0.06%	2.95%
S&P	−0.17%	0.83%	−3.42%	0.81%	0.48%	0.97%	0.05%	5.10%

Table 2
Statistics for returns and volatility for epidemic and pandemic times. The Coronavirus (COVID-19) has been classified as an epidemic from its emergence to March 10, 2020. Post-March 10, 2020 it has been classified as Pandemic by as per the World Health Organization.

		Daily return				EGARCH volatility			
		Mean	Standard dev	Min	Max	Mean	Standard dev	Min	Max
EPIDEMIC	WRLD	−0.28%	1.66%	−7.44%	3.27%	0.04%	0.07%	0.00%	0.29%
	EUR	−0.41%	1.49%	−6.92%	1.64%	0.49%	2.30%	0.00%	15.51%
	USA	−0.23%	2.04%	−7.99%	4.77%	0.06%	0.11%	0.00%	0.57%
	ASIA	−0.23%	1.07%	−4.17%	1.90%	0.01%	0.02%	0.00%	0.06%
	ITL	−0.53%	2.09%	−11.01%	2.41%	0.48%	2.10%	0.01%	13.21%
	SPN	−0.47%	1.70%	−7.88%	1.76%	0.29%	1.33%	0.01%	8.87%
	CHN	−0.08%	1.47%	−4.44%	2.81%	0.04%	0.04%	0.00%	0.18%
	GER	−0.44%	1.53%	−7.15%	1.49%	0.04%	0.06%	0.00%	0.19%
	FRA	−0.46%	1.57%	−7.52%	1.69%	0.03%	0.04%	0.00%	0.16%
	KOR	−0.25%	2.02%	−5.61%	3.83%	0.05%	0.04%	0.01%	0.15%
	SWZ	−0.20%	1.29%	−4.58%	2.08%	0.53%	3.43%	0.01%	24.03%
	UK	−0.52%	1.58%	−7.60%	1.57%	0.04%	0.05%	0.00%	0.21%
	BC	0.22%	3.84%	−15.07%	6.96%	0.19%	0.26%	0.03%	1.07%
	WTI	−1.15%	5.89%	−38.83%	9.87%	1.75%	8.81%	0.00%	62.11%
	GLD	0.17%	0.95%	−3.78%	2.59%	0.02%	0.01%	0.01%	0.04%
	Trsry	0.16%	0.54%	−2.05%	1.82%	0.26%	0.44%	0.06%	2.36%
	S&P	0.08%	0.36%	−1.74%	0.81%	0.15%	0.17%	0.05%	0.86%
		Daily return				EGARCH volatility			
		Mean	Standard dev	Min	Max	Mean	Standard dev	Min	Max
PANDEMIC	WRLD	−2.72%	5.97%	−10.44%	5.75%	0.29%	0.10%	0.18%	0.48%
	EUR	−2.42%	5.44%	−14.06%	1.81%	276.49%	778.65%	0.06%	2203.55%
	USA	−2.83%	7.43%	−12.92%	8.71%	0.41%	0.26%	0.21%	0.93%
	ASIA	−2.11%	2.40%	−5.19%	2.75%	0.07%	0.02%	0.05%	0.09%
	ITL	−2.27%	8.13%	−20.54%	6.60%	0.26%	0.54%	0.01%	1.58%
	SPN	−2.41%	7.26%	−17.22%	5.32%	0.25%	0.35%	0.01%	1.03%
	CHN	−1.54%	3.33%	−6.09%	3.79%	0.05%	0.04%	0.01%	0.10%
	GER	−2.85%	5.98%	−15.09%	3.69%	0.20%	0.04%	0.14%	0.27%
	FRA	−2.48%	6.44%	−14.90%	5.12%	0.30%	0.06%	0.21%	0.39%
	KOR	−3.18%	5.90%	−11.00%	10.05%	0.28%	0.11%	0.14%	0.44%
	SWZ	−1.50%	4.46%	−11.33%	3.91%	4.12%	11.34%	0.01%	32.17%
	UK	−2.90%	5.35%	−14.21%	1.26%	0.16%	0.04%	0.11%	0.22%
	BC	−3.66%	14.25%	−31.57%	15.83%	0.19%	0.26%	0.03%	1.07%
	WTI	−3.53%	13.69%	−27.99%	21.36%	1.75%	8.81%	0.00%	62.11%
	GLD	−1.34%	2.32%	−4.88%	2.45%	0.02%	0.01%	0.01%	0.04%
	Trsry	−0.14%	1.41%	−2.10%	1.74%	0.26%	0.44%	0.06%	2.36%
	S&P	−1.70%	1.20%	−3.42%	0.73%	0.15%	0.17%	0.05%	0.86%

going to expand the scope by looking at the impact on different financial securities (Equity, Debt, Bitcoin, Gold, Oil) to provide broad directions to investors.

Some new and interesting results can be observed from this study; China showed a relatively lower decrease in returns in both epidemic and pandemic period while for the bigger economies such as the US, UK, Germany and South Korea the overall average volatility increased tremendously from epidemic to pandemic period. Secondly, the EU regional index showed the highest volatility in the US phase even though the European phase

(Phase II) recorded a higher number of casualty. Lastly, Gold showed the least volatility among all the securities.

2. Data & methodology

To study the impact of COVID-19 crisis on financial markets' volatility, we have compiled the dataset of the daily prices and

Table 3

Statistics for returns and volatility for global spread phases. COVID-19 spread can be classified into three distinct phases. Phase I is when fatality was localized in China, which runs from Jan 1, 2020, to Feb 14, 2020. Phase II is when fatalities started happening in Europe, which runs from Feb 15, 2020, to Feb 28, 2020. Phase III, is when fatalities happened in the US as well which lasts till date.

		Daily return				EGARCH volatility			
		Mean	Standard dev	Min	Max	Mean	Standard dev	Min	Max
PHASE I	WRLD	0.09%	0.57%	−1.65%	1.35%	0.00%	0.07%	0.01%	0.01%
	EUR	−0.01%	0.67%	−2.39%	1.43%	0.00%	0.00%	0.00%	0.00%
	USA	0.15%	0.70%	−1.77%	1.55%	0.00%	0.07%	0.01%	0.01%
	ASIA	−0.01%	0.83%	−1.97%	1.90%	0.03%	1.64%	0.06%	0.07%
	ITL	0.04%	0.93%	−2.34%	2.41%	0.00%	0.07%	0.01%	0.01%
	SPN	0.04%	0.75%	−2.10%	1.51%	0.01%	0.29%	0.01%	0.02%
	CHN	0.05%	1.30%	−2.91%	2.81%	0.00%	0.00%	0.00%	0.00%
	GER	−0.01%	0.84%	−2.71%	1.40%	0.03%	1.64%	0.06%	0.07%
	FRA	−0.04%	0.72%	−2.63%	1.39%	0.00%	0.07%	0.01%	0.01%
	KOR	0.06%	1.61%	−3.87%	3.83%	0.01%	0.29%	0.01%	0.02%
	SWZ	0.10%	0.54%	−1.46%	1.31%	0.00%	0.00%	0.00%	0.00%
	UK	−0.11%	0.69%	−2.41%	1.57%	0.03%	1.64%	0.06%	0.07%
	BC	1.12%	2.82%	−3.54%	6.96%	0.00%	0.07%	0.01%	0.01%
	WTI	−0.48%	1.68%	−5.05%	3.01%	0.00%	0.00%	0.00%	0.00%
	GLD	0.12%	0.60%	−1.34%	1.33%	0.03%	1.64%	0.06%	0.07%
	Trsry	0.06%	0.27%	−0.57%	0.57%	0.00%	0.07%	0.01%	0.01%
	S&P	0.08%	0.21%	−0.36%	0.43%	0.01%	0.29%	0.01%	0.02%
		Daily return				EGARCH volatility			
		Mean	Standard dev	Min	Max	Mean	Standard dev	Min	Max
PHASE II	WRLD	−1.27%	1.40%	−3.67%	0.40%	0.04%	1.66%	0.02%	0.10%
	EUR	−1.23%	1.61%	−3.79%	0.55%	0.00%	0.01%	0.00%	0.00%
	USA	−1.35%	1.70%	−4.52%	0.49%	0.04%	1.66%	0.02%	0.10%
	ASIA	−0.86%	0.60%	−2.09%	0.13%	0.16%	15.51%	0.09%	0.34%
	ITL	−1.08%	2.12%	−5.29%	1.44%	0.04%	1.66%	0.02%	0.10%
	SPN	−1.17%	1.73%	−3.88%	0.93%	0.05%	4.87%	0.03%	0.13%
	CHN	−0.56%	1.06%	−2.20%	0.79%	0.00%	0.01%	0.00%	0.00%
	GER	−1.27%	1.55%	−3.94%	0.72%	0.16%	15.51%	0.09%	0.34%
	FRA	−1.16%	1.55%	−3.75%	0.54%	0.04%	1.66%	0.02%	0.10%
	KOR	−1.51%	1.94%	−4.92%	2.05%	0.05%	4.87%	0.03%	0.13%
	SWZ	−1.07%	1.59%	−3.54%	0.86%	0.00%	0.01%	0.00%	0.00%
	UK	−1.36%	1.77%	−3.97%	0.32%	0.16%	15.51%	0.09%	0.34%
	BC	−1.76%	3.87%	−7.08%	5.24%	0.04%	1.66%	0.02%	0.10%
	WTI	−1.00%	2.23%	−4.72%	2.35%	0.00%	0.01%	0.00%	0.00%
	GLD	0.03%	1.65%	−3.78%	1.90%	0.16%	15.51%	0.09%	0.34%
	Trsry	0.34%	0.35%	−0.09%	1.11%	0.04%	1.66%	0.02%	0.10%
	S&P	0.18%	0.29%	−0.17%	0.81%	0.05%	4.87%	0.03%	0.13%
		Daily return				EGARCH volatility			
		Mean	Standard dev	Min	Max	Mean	Standard dev	Min	Max
PHASE III	WRLD	−1.73%	5.05%	−10.44%	5.75%	0.23%	147.81%	0.03%	0.30%
	EUR	−1.83%	4.39%	−14.06%	1.81%	0.08%	0.00%	0.00%	0.02%
	USA	−1.69%	6.29%	−12.92%	8.71%	0.23%	147.81%	0.03%	0.30%
	ASIA	−1.29%	2.34%	−5.19%	2.75%	0.48%	2203.55%	0.12%	0.93%
	ITL	−2.35%	6.37%	−20.54%	6.60%	0.23%	147.81%	0.03%	0.30%
	SPN	−2.17%	5.60%	−17.22%	5.32%	0.10%	568.71%	0.03%	0.25%
	CHN	−0.84%	2.97%	−6.09%	3.79%	0.08%	0.00%	0.00%	0.02%
	GER	−2.11%	4.73%	−15.09%	3.69%	0.48%	2203.55%	0.12%	0.93%
	FRA	−1.99%	5.07%	−14.90%	5.12%	0.23%	147.81%	0.03%	0.30%
	KOR	−1.67%	4.97%	−11.00%	10.05%	0.10%	568.71%	0.03%	0.25%
	SWZ	−0.97%	3.62%	−11.33%	3.91%	0.08%	0.00%	0.00%	0.02%
	UK	−2.13%	4.41%	−14.21%	1.49%	0.48%	2203.55%	0.12%	0.93%
	BC	−2.49%	11.02%	−31.57%	15.83%	0.23%	147.81%	0.03%	0.30%
	WTI	−3.98%	14.10%	−38.83%	21.36%	0.08%	0.00%	0.00%	0.02%
	GLD	−0.43%	2.04%	−4.88%	2.59%	0.48%	2203.55%	0.12%	0.93%
	Trsry	0.10%	1.32%	−2.10%	1.82%	0.23%	147.81%	0.03%	0.30%
	S&P	−0.93%	1.31%	−3.42%	0.73%	0.10%	568.71%	0.03%	0.25%

returns of MSCI indices for the top nine countries[3] affected by COVID-19 Pandemic, namely China, United States of America, United Kingdom, Italy, Spain, France, Germany, Switzerland and South Korea along with some regional indices namely World (WRLD), Europe (EU) and Asia. Additionally, we have included corporate bonds index (S&P 500), US treasury bonds core index (ICE core), Bitcoin, Oil (WTI spot) and Gold in our dataset.

Our sample period runs from 1 January 2020 till 20 March 2020 for the benchmark indices. In this case, we have 58 observations. This is owing to the limited availability of the data as

well as the self-imposed constraint where we want the data to not have an impact of the stimulus packages announced by the US government in supporting the financial markets.

To understand the volatility of the financial markets, we rely on Exponential GARCH models which have been extensively used in studying the volatility of financial markets in finance literature. Yu and Hassan (2008), Rizvi et al. (2018) etc. have relied on asymmetric GARCH model developed by Nelson (1991) suggesting a better fit of EGARCH model for volatilities. The EGARCH model presides over other models with its ability to allow for a more stable optimization of routines, and no parameter

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[3] Except Iran, for which data is not available.
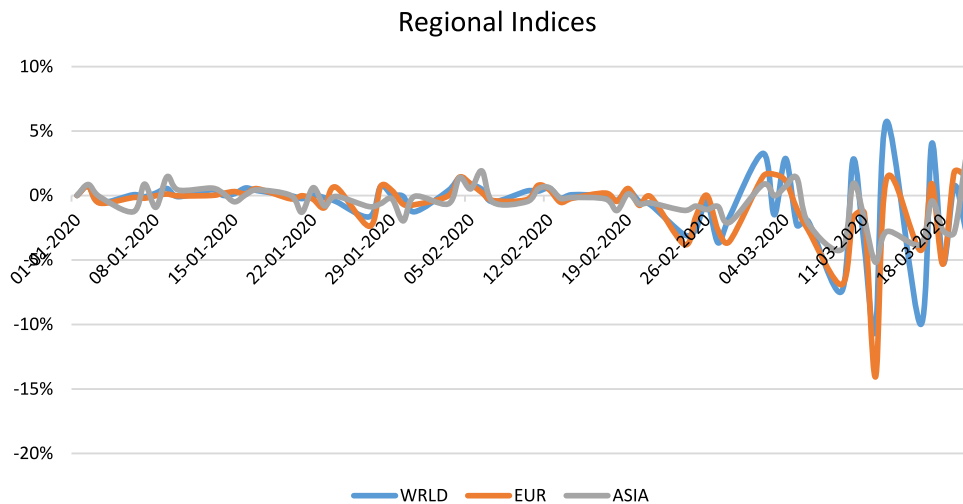
Regional Indices

Fig. 1. Return of regional indices.

constraints.

$$ln\sigma_{j,t}^2 = \omega_t + \beta_j \ln(\sigma_{j,t-1})^2 + \gamma \frac{\varepsilon_{t-1}}{\sqrt{\sigma_{t-1}^2}} + \alpha \left[\frac{|\varepsilon_{t-1}|}{\sqrt{\sigma_{t-1}^2}} - \sqrt{\frac{2}{\pi}} \right] \quad (1)$$

where $\sigma_{j,t}^2$ denotes the conditional variance since it is a one-period ahead estimate for the variance calculated on any past relevant information. ω_t symbolizes a conditional density function. The α consideration represents the symmetric effect of the model, i.e. the GARCH effect. β calculates the perseverance in conditional volatility irrespective of market movements. Furthermore, the parameter γ measures the leveraging effect.

We have also run bivariate regression between returns and volatility of different financial securities and Covid19 deaths.

3. Analysis

Table 1 shows the returns and volatility for the overall period. Negative returns and higher volatility is observed in all financial securities and commodities except for the US treasury bonds, suggesting the investor sentiment and perceived uncertainty created by the COVID-19 outbreak. Tetlock (2007) and Kaplanski and Levy (2010) have earlier suggested investor sentiment in times of economic uncertainty to have effected market returns and volatility. Among the non-debt securities, Gold showed relative stability. Crude Oil has the highest volatility during this period, but that cannot be attributed wholly to the pandemic, but also due to the regional disputes among oil-producing nations. The higher volatility of oil prices runs contrary to Gkillas et al. (2020), who argued for financial stress improving oil price forecasts. As far as equity markets are concerned, the European stock markets showed the highest sensitivity towards the pandemic.

Table 2 highlights that the global markets uncertainty increased with the shift to the pandemic stage (11th March 2020 onwards). The equity market declines amplified in pandemic stage, evident from higher negative returns. European markets registered higher negative returns as compared to other markets. This may be attributed to higher media coverage in the pandemic period leading to negative sentiments which caused markets to decline and volatility to rise (Engelberg and Parsons, 2011; Peress, 2014; Donadelli, 2015). Another possible reason for this sudden fall could be that most of the European countries announced lockdown around the start of the pandemic phase[4] resulting

in a shut down of almost all the economic activities which is bound to affect the markets. Another important point to note is that the Chinese market showed a lower decline in retains and remained stable. This could be attributed to the hopes supported by the government's claims that the Coronavirus outbreak is under control in China itself, and the anticipation of further easing measures in fiscal policy to support the economy. Following equity markets, debt-based securities in our sample showed higher levels of volatility in the pandemic period as compared to the epidemic period. As far as commodities are concerned, Bitcoin started to show its inherent weakness during a tough financial condition during the pandemic period and registered the biggest average negative return of -3.66% in the pandemic period. Gold which remained reasonably less volatile in epidemic period started showing a decline in returns during pandemic period but in terms of volatility, it is found to be the least volatile supporting the notion of "Gold a safe-haven asset" (Reboredo, 2013).

Table 3 shows the returns and volatilities of securities during three phases, starting from casualties in China (which shows China as an epicentre of the epidemic) to the start of casualties in Europe (epicentre shifted to Europe) and lastly, when casualties started in the US (the new epicentre). For a better understanding of the split in phases, the global financial markets volatility increased once the casualty numbers started rising outside China. Phase 3, which recorded casualties in the US, further enhanced the financial market volatilities impacting commodities like gold which were relatively shielded in earlier findings and overall had least negative returns. Chinese market's volatility levels did not vary drastically in the three phases suggesting a lower global integration and early actions taken by the authorities to contain the Coronavirus spread. Interestingly European markets' volatility enhanced in Phase 3, rather than Phase 2, which is the European spread. As discussed earlier, this may be attributed to the delayed reaction from the European premiers as compared to their Asian counterparts,[5] where they imposed lockdown during phase 3 instead of phase 2, which is considered as one of the main reasons for Coronavirus spread in the continent (Sohrabi et al., 2020). In terms of the regional indices (Fig. 1), Asia recorded the lowest volatility while the EU regional index showed the highest volatility during the US phase. For Bitcoin, the larger negative returns in Phase 2 and 3, suggest a contagion effect with equity

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[4] https://www.dw.com/en/coronavirus-what-are-the-lockdown-measures-across-europe/a-52905137.

[5] https://www.euronews.com/2020/03/20/coronavirus-did-europe-lockdown-too-late-amid-the-covid-19-outbreak-culture-clash.

Table 4

Bivariate regression (Independent variable: Covid19 deaths). This table shows the bivariate relationship between returns and volatility of different financial securities and Covid19 deaths.

Bivariate regression (Independent variable: Covid19 deaths)				
Dependent variable	Returns		Volatility	
	Coef.	t-stats	Coef.	t-stats
WRLD	−0.0017557*	−1.85	0.0001745***	5.19
EUR	−0.001646*	−1.93	0.001327*	1.61
ASIA	−0.001273**	−2.59	0.0000416***	6.04
ITL	−0.0018846	−1.54	0.0010003	1.44
SPN	−0.0017041	−1.59	0.0006576	1.49
CHN	−0.0009452	−1.45	−5.89E−06	−0.43
GER	−0.0018756**	−2.04	0.0001397***	6.76
FRA	−0.0016853*	−1.74	0.0001647***	5.32
KOR	−0.0018842*	−1.83	0.0001531***	5.24
SWZ	−0.0011381	−1.61	0.002421	1.29
UK	−0.0018748**	−2.17	0.0001209***	6.79
USA	−0.0018173	−1.55	0.000244***	4.2
BC	−0.0035129	−1.6	0.000511***	4.45
WTI	−0.0025533	−0.98	0.0034437	1.18
GLD	−0.000548	−1.18	4.29E−06	1.01
Trsry	6.65E−06	0.03	0.0010561***	4.75
S&P	−0.0007713***	−2.76	0.0011414***	3.69

*$p < 0.1$.

**$p < 0.05$.

***$p < 0.01$.
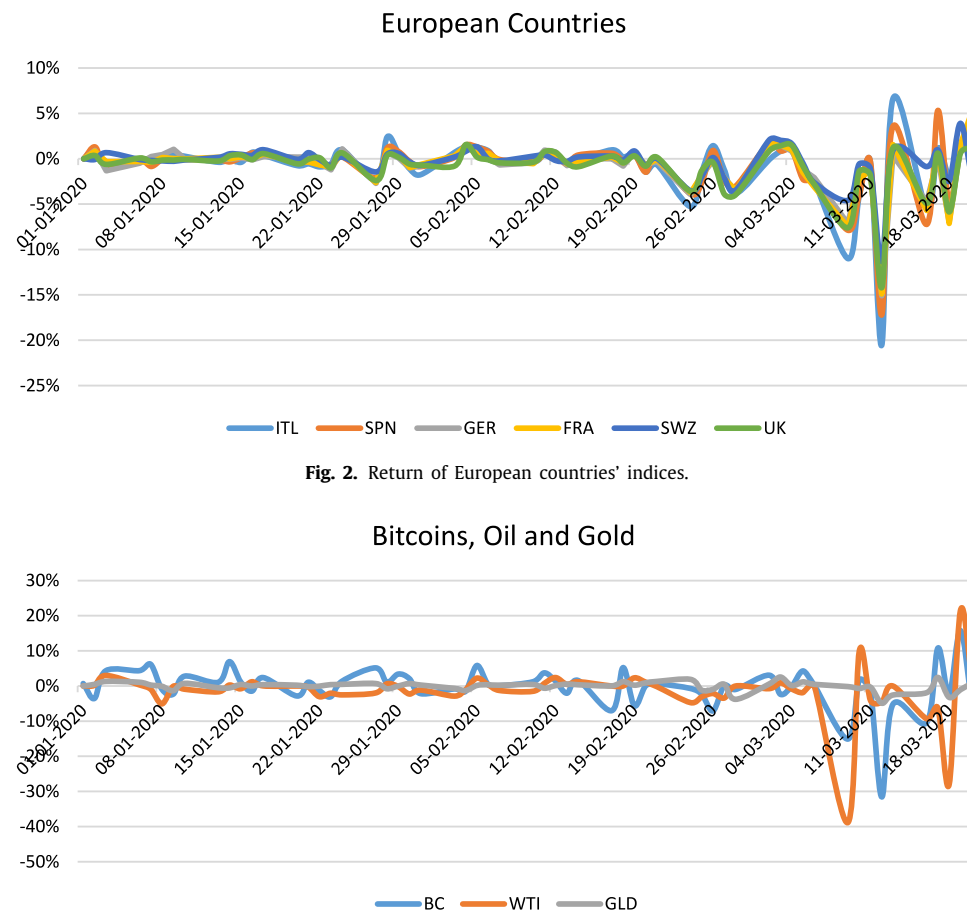
Fig. 2. Return of European countries' indices.
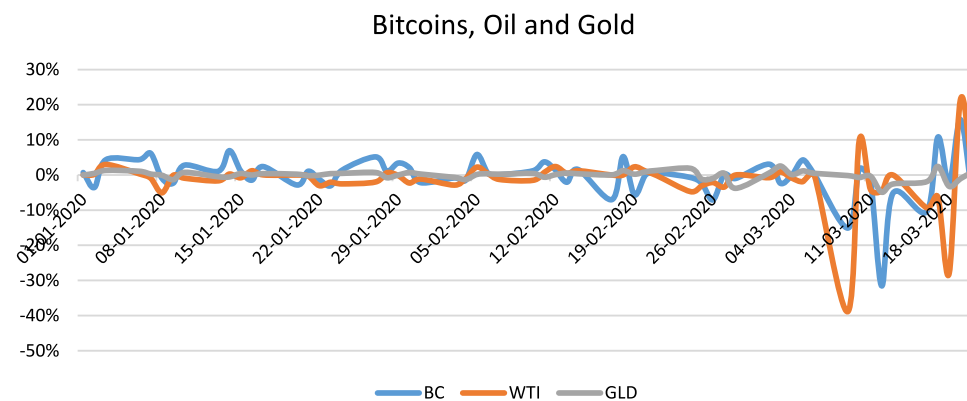
Fig. 3. Return of Bitcoins, Oil and Gold.

markets during financial turmoil. Similar to our earlier discussion, Chinese stock markets and Gold remained less volatile in the US phase.

To add credence to our discussion, we ran bivariate regressions to see the impact of COVID-19 deaths on the returns and volatility on different financial securities. The results are reported in Table 4. We find returns of most of the financial securities to be negatively and significantly related to the COVID-19 deaths. On the other hand, the volatility of most of the securities is found to be positively related to the deaths, which means that securities become more volatile as the number of deaths due to COVID-19

pandemic. These results are in line with our earlier findings (see Figs. 2 and 3).

4. Conclusion

Coronavirus has emerged as a bane for the financial markets with unexpected levels of uncertainty and high volatility. Within 100 days, nearly 30% of wealth has eroded off the bourses globally. Our findings suggest towards a more increasingly panic and quickly deteriorating situation in the markets as Coronavirus moved from epidemic to pandemic. The situation has worsened as the global spread has gone beyond geographical and continental boundaries, with even safer commodities like gold returns turning negative as COVID-19 spreads to the US but still found to be least volatile. Chinese stock markets recovered in the US phase owing to the timely actions taken by the authorities.

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